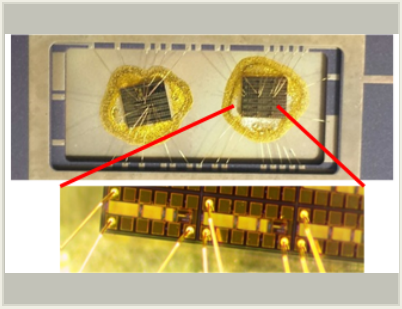
Extreme Environment Electronics Based on Silicon Carbide, Phase II

Completed Technology Project (2016 - 2019)

Project Introduction

Radiation tolerant, extreme temperature capable electronics are needed for a variety of planned NASA missions. For example, in-situ exploration of Venus and long duration Europa-Jupiter missions will expose electronics to temperatures up to 500°C and radiation of 3 Mrad (Si) total dose. During this program, United Silicon Carbide will extend the capability of its SiC JFET integrated circuit (IC) fabrication technology to produce electronics compatible with such extreme environments. Silicon Carbide (SiC) junction field effect (JFET) based electronics are ideal for these environments due to their radiation tolerance and their high performance and reliability over an extremely wide operating temperature range. SiC electronics can be used in applications ranging from low power, low noise mixed signal electronics for precision actuator control, sensor interfaces, and guidance and navigation electronics to power electronics for power management and distribution and power processing units. SiC based electronics will have longer storage and operating lifetimes when compared to existing silicon electronics. Use of SiC integrated circuits will also lower system mass, volume, and power by reducing or eliminating the need for cooling and radiation shielding. In Phase I, we showed the feasibility of our approach by measuring SiC JFET IC device characteristics at 500°C; performing a 500 hour, 500°C reliability test; and using TCAD simulations to further explore the devices behavior at high temperature and when subjected to radiation. In Phase II, we will fully develop the extreme environment capable SiC IC fabrication technology and use it to fabricate an integrated circuit which will be characterized at 500°C and before and after radiation exposure. Following Phase II, we will provide access to the process technology and related design intellectual property through a commercial fabrication service so that NASA and others can fully leverage its capability.



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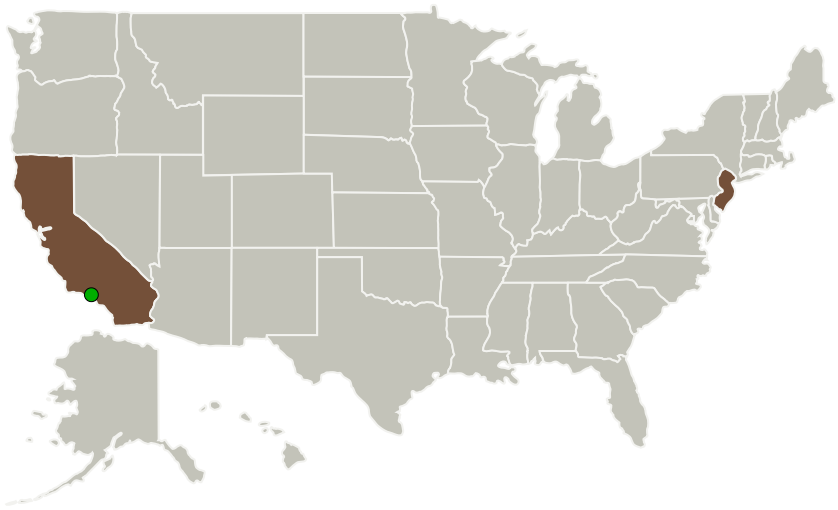
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
United Silicon Carbide, Inc.	Lead Organization	Industry	Monmouth Junction, New Jersey
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	New Jersey

Project Transitions

May 2016: Project Start

May 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139579)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

United Silicon Carbide, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Peter Alexandrov

Co-Investigator:

Matthew O'grady

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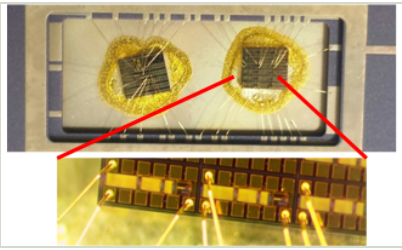
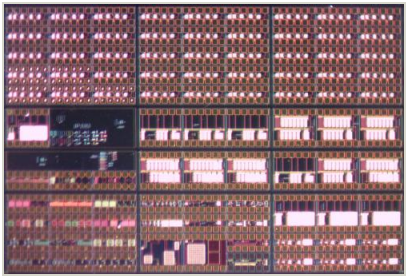
Images



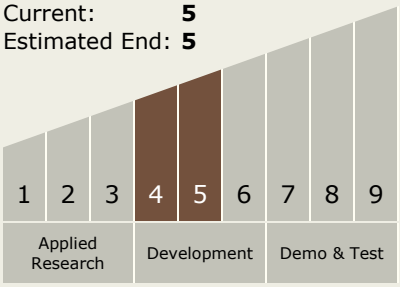
Briefing Chart Image
Extreme Environment Electronics based on Silicon Carbide, Phase II *(https://techport.nasa.gov/image/134215)*



Final Summary Chart Image
Extreme Environment Electronics Based on Silicon Carbide, Phase II *(https://techport.nasa.gov/image/127029)*

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.4 Advanced Propulsion
    - TX01.4.1 Solar Sails

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System